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1.1. INTRODUCTION

This list of vegetation types is intended to provide a coarse overview of the dominant terrestrial vegetation types and their arrangement across the Klamath region. Nearly all these vegetation types vary substantially from place to place and through time, and contain many unique (micro) habitats that for brevity are not included here.

1.2. COASTAL ENVIRONMENTS

A. Coastal Sand and Dune

Along the coastal dunes and the foggiest and most windswept bluffs, highly distinct plant communities occur. On the coastal strand and foredunes, coastal sand verbena (*Abronia latifolia),* silver burr ragweed (*Ambrosia chamissonis*), and European sea rocket (*Cakile maritima*) are common. Dune habitats have American dunegrass (*Leymus mollis* ssp.*mollis*), and the non-native European beachgrass (*Ammophila arenaria*), with woody plants, such as willow (*Salix* spp.) and coyote brush (*Bacharis pilularis*) becoming more important with greater distance from the sea.

B. Coastal Prairie

On moist coastal terraces and windswept hilltops in the redwood zone, productive perennial grasslands occur. These prairies are dominated by California oatgrass (*Danthonia californica*), red fescue (*Festuca rubra*), Idaho fescue (*Festuca idahoensis*), and Pacific hairgrass (*Deschampsia caespitosa* ssp. *holciformis*). These coastal prairies are under threat from invasive plant species, tree encroachment, and agriculture.

C. Coastal Forest

A maritime coniferous forest of shore pine (*Pinus contorta* var. *contorta*) and Sitka spruce (*Picea sitchensis*) occurs in a thin coastal strip between the foredunes and the redwood forests. Strong winds and salt spray from the ocean limit branch growth in the seaward direction and produce spectacular "flagged" trees and shrubs along the bluffs and headlands.

1.3. LOW ELEVATION ENVIRONMENTS (KLAMATH)

A. Redwood Forest

These massive forests, dominated by the coastal redwood (*Sequoia sempervirens*), contain the tallest trees and highest biomass concentrations in the world. The forests are restricted to the fog-affected coastal strip, just inland from areas of salt spray, where redwoods reach their greatest size in alluvial habitats. Associated tree species include Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), western redcedar (*Thuja plicata*), Port-Orford cedar (*Chamaecyparis lawsoniana*), tanoak (*Lithocarpus densiflorus*), red alder (*Alnus rubra*), and bigleaf maple (*Acer macrophyllum*). Common shrubs include salmonberry (*Rubus spectabilis*), salal (*Gaultheria shallon*), and evergreen huckleberry (*Vaccinium ovatum*). Sword fern (*Polystichum munitum*) is an important groundcover.

B. Mixed Evergreen Forest

These forests often occur just inland or at higher elevations than the summer fog belt, and have much warmer summers, but experience mild, wet weather most of the year. These mixed conifer/broadleaved evergreen forests are believed to be the remnants of forest types that cloaked large areas of the west in the Tertiary (Whittaker 1960, 1961). Douglas-fir (*Pseudotsuga menziesii*) is the dominant conifer and usually comprises most of the biomass in these forests. Other minor conifers include knobcone pine (*Pinus attenuata*), grand fir (*Abies grandis*), Port-Orford cedar (*Chamaecyparis lawsoniana*) and yew (*Taxus brevifolia*). Associated hardwood species, many of which are evergreen, give these forests their distinctive character. They include tanoak, canyon oak (*Quercus chrysolepis),* madrone (*Arbutus menziesii*), bay (*Umbellularia californica*), and chinquapin (*Chrysolepis chrysophylla*). Common shrubs include hazelnut (*Corylus cornuta*), Oregon grape (*Berberis nervosa*), oceanspray (*Holodiscus discolor*), salal, and poison oak (*Toxicodendron diversilobum*).

C. Oak/Pine Woodlands

Oak vegetation often intermixes with and can be difficult to separate from chaparral, grasslands, and mixed conifer forest along the drier edges of the interior valleys. Severe summer drought lowers stand densities in these woodlands, which are dominated by Oregon oak and California black oak. Ponderosa pine is often scattered among the oaks. At the edge of the Sacramento Valley, gray pine (*Pinus sabiniana*), blue oak (*Quercus douglasii*), valley oak (*Quercus lobata*), and buckeye (*Aesculus californica*) become important. Most of the species mentioned for chaparral above can be found in these stands. More typically, the ground layer is composed of annual grasses and forbs. As with chaparral, fire is believed to be an especially important factor structuring these vegetation types.

D. Chaparral

This distinctive physiognomic type, which includes a variety of associations dominated by sclerophyllous shrubs, occurs as a seral type in many forests types in the region and appears as a more permanent drought and fire-adapted type at lower elevations abutting the Rogue and Sacramento valleys. Trees often occur as scattered individuals in the communities, including ponderosa pine, white fir, or oaks. Common species in Klamath chaparral are various species of manzanita (*Arctostaphylos* spp.), wedgeleaf ceanothus (*Ceanothus cuneatus*), deerbrush (*Ceanothus integerrimus*), chamise (*Adenostoma fasciculatum*), silk-tassel (*Garrya fremontii*), birchleaf mountain mahogany (*Cercocarpus betuloides*), and Klamath plum (*Prunus subcordata*). Many native and exotic grasses and forbs occur in these communities, yielding a very species-rich flora.

1.4. MID ELEVATION ENVIRONMENTS

A. Mixed Conifer Forests

These forests typically occur at middle elevations in the Klamath-Siskiyou subregion and comprise the most diverse conifer forests in North America. They are generally

dominated by fir, but pine-dominated forests occur as well. Due to variation in climate and geology they are quite distinct in structure and composition across the subregion. Typical tree species include Douglas-fir, white fir (*Abies concolor*), sugar pine (*Pinus lambertiana*), incense cedar (*Calodedrus decurrens*), yew, and ponderosa pine (*Pinus ponderosa*). Less widespread but locally abundant species include jeffrey pine (*Pinus jeffreyi*), grand fir, Port-Orford cedar, and knobcone pine. Shasta red fir (*Abies magnifica* var. *shastensis*) becomes common at highest elevations of these forests. Forest understories vary greatly across the region, due to climate differences. Common hardwoods and shrub species include Pacific dogwood (*Cornus nuttallii*), canyon oak, California black oak (*Quercus kelloggii*), and bigleaf maple. Typical understory shrubs and subshrubs include the endemic Sadler's oak (*Quercus sadleriana*), greenleaf manzanita (*Arctostaphylos patula*), prince's pine (*Chimaphila umbellata*), and mahala mat (*Ceanothus prostratus*).

In the Cascades, these forest are essentially similar, but contain fewer endemic species and a greater complement of northern species, as well as Rocky Mountain species, such as Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*), especially near Crater Lake.

B. Montane Chaparral

Montane chaparral occurs at higher elevations than the main realm of this vegetation (1,000-3,000 m) and is dominated by a different set of shrubs. It is less common in the Cascades. This community may be relatively persistent where edaphic factors limit tree growth. More commonly, it regenerates following stand-replacing fire in conifer forests. In these cases, its persistence will depend on the frequency and severity of subsequent fires. Montane chaparral has thus been described as having a self-reinforcing relationship with fire (Show and Kotok, 1924). Greenleaf manzanita (*Arctostaphylus patula*) and several ceanothus species, huckleberry oak, and chinquapin (*Castanopsis sempervirens*) are common evergreen shrubs in montane chaparral. There is often a deciduous shrub component (e.g. *Ceanothus integerrimus*).

1.5. Upper Montane, Subalpine, and Alpine Environments

A. Subalpine Forests

Subalpine forests dominated by whitebark pine (*Pinus albicaulis*), Shasta red fir, western white pine (*Pinus monticola*), and mountain hemlock (*Tsuga mertensiana*) occur at high elevation throughout the region. In the Cascades, engelmann spruce, subalpine fir, and lodgepole pine (*Pinus contorta* ssp. *latifolia*) are also abundant. Shrubs include huckleberry oak (*Quercus vaccinifolia*), greenleaf manzanita, and pinemat manzanita (*Arctostaphylos nevadensis*) on dry slopes, and Sitka alder (*Alnus viridis* ssp. *sitchensis*), black swamp currant (*Ribes lacustre*), and red-osier dogwood (*Cornus sericea*) in wetter areas.

B. Montane and Subalpine Meadows

Sedge and forb meadows are common at middle to high elevations across the region and harbor many species-rich plant associations. In many cases they are associated with wetlands or areas with shallow water tables. Moisture loving forbs such as false hellebore (*Veratrum californicum*), speedwell (*Veronica* spp.), American bistort (*Polygonum bistortoides*), cow parsnip (*Heracleum lanatum*), and lillies (*Lillium* spp.) are common, usually mixed with graminoids such as tufted hairgrass (*Deschampsia caespitosa*), meadow barley (*Horeum brachyantherum*) and species-rich assemblages of sedges (*Carex* spp.) and rushes (*Juncus* spp.). Drier meadows dominated by yarrow (*Achillea millefolium*), Arnica (*Arnica* spp.), Fescue (*Festuca* spp.), and California oatgrass. Historical overgrazing was ubiquitous in these community types and many protected meadows are still degraded due to gully erosion or a high abundance of invasive plant species.

C. Alpine Vegetation

This varied vegetation type is relatively rare in the Klamath Region overall, but is well represented on Lassen Peak, and secondarily on Mount Scott and rim areas of Crater Lake National Park. The alpine flora comprises circumboreal alpine genera (*Cassiope*, *Phyllodoce*, *Kalmia*), as well as taxa derived from the more xeric low elevation floras (e.g., *Eriogonum*, *Penstemon*) (Major and Taylor 1977). Alpine flora is internally heterogeneous with considerable floristic variation from rocky, exposed slopes to concave, sheltered areas with late lying snows. Despite their small area, alpine areas are zones of high endemism (Major and Taylor 1977) where rare, endemic, or disjunct species are found, including *Draba aureola* and *Smelowskia ovalis* var. *congesta* on Lassen Peak and *Botrychium pumicola* on the Crater Lake rim.

1.6. East Cascade/Great Basin Environments

A. Ponderosa Pine

A cooler, drier variant of this type, usually dominated by ponderosa or jeffrey pine, is widespread along the eastern slopes of the Cascades. Although oaks may be mixed with the pines, especially near the heads of west flowing river valleys, these types typically have understories similar to the adjacent steppe. Common shrub species include big sagebrush (*Artemisia tridentata*) or bitterbrush (*Purshia tridentata*), chokecherry, or wedgeleaf ceanothus. In frost-prone depressions, lodgepole pine may be locally dominant.

B. Juniper Savanna/Woodland

Along the eastern edges of the Cascades and on the Modoc Plateau, western juniper (*Juniperis occidentalis*) occurs in open stands, with occasional individuals of jeffrey or

ponderosa pine. The understory typically includes big sagebrush, bitterbrush, rabbitbrush (*Chrysothamnus nauseosus*), and desert currant (*Ribes cereum*). Perennial bunchgrasses are usually present, including Idaho fescue (*Festuca idahoensis*), bottlebrush squirreltail (*Elymus elymoides*), and needlegrass (*Stipa* spp.).

C. Sagebrush Steppe

This community occurs over large expanses of the Modoc Plateau in various forms. The most abundant species is big sagebrush, with bitterbrush or rabbitbrush present. Low sagebrush (*Artemisia arbuscula*) is also locally dominant on areas with shallow soils. Where groundwater comes close to the surface, such as at toeslopes or riparian areas, stands of aspen (*Populus tremuloides*) occur. With the shrubs are various mixtures of native bunchgrasses, including Idaho fescue, needlegrasses, bottlebrush squirrel tail, bluebunch wheatgrass (*Pseudoroegneria spicata*), and Sandberg's bluegrass (*Poa secunda*). Although widespread, these communities are regionally threatened by invasive species, such as cheatgrass (*Bromus tectorum*) and medusahead (*Taeniatherum caput-madusae*).

D. Rosaceous Shrubland

These unique winter-deciduous shrublands occur along escarpments and droughty slopes of the eastern Cascades, and in scattered locations in the eastern Klamath-Siskiyou subregion. They are dominated by tall shrubs, usually including antelope bitterbrush (*Purshia tridentata*), and on somewhat wetter sites, also including birchleaf mountain mahogany, Saskatoon serviceberry (*Amelanchier alnifolia*), bitter cherry (*Prunus emarginata*), chokecherry (*Prunus virginiana*), and rose (*Rosa* spp.). They have similar herbaceous species to the surrounding sagebrush steppe.

1.7. HYDROLOGICALLY-INFLUENCED ENVIRONMENTS

The seasonal to permanent influence of water and it many physical and chemical effects creates a broad suite of floristic communities that parallel the variety in upland vegetation in the Klamath region. Across this complex region, hydrologically-influenced environments occur in most landscape settings and span a gradient from permanently flooded marshes and estuaries to seasonally flooded riparian forests and intermittently flooded gullies and vernal pools. Below we describe several major types of hydrologically influenced vegetation along a hydrologic continuum from permanently to intermittently flooded environments.

A. True Wetlands

True wetlands include sites with semipermanent or permanently wet soils and associated hydric soils and vegetation. These wetlands take a number of forms.

Freshwater marshes- occur throughout the region from the deflation plain wetlands in the lee of coastal dunes to the subalpine environments of the Lassen uplands. The most common species in these environments include obligate wetland species including cattail (*Typha latifolia*), bulrush (*Scirpus* spp.), and any of a large number of sedge (*Carex*) species. Most dominant species are large (0.5-2.0 m in height), clonal graminoids with physiological adaptations to flooding.

Fens and seeps- are usually true wetlands situated at areas of consistent groundwater discharge. Owing to the mineral-laden groundwater flowing through them, these wetlands often harbor highly distinctive or rare species, such as the California pitcher plant (*Darlingtonia californica*) and the globally rare Howell's alkali grass (*Puccinellia howellii*).

B. Riparian Forests and Shrublands

Riparian communities range from cottonwood gallery forests at low elevations to subalpine meadows and willow carrs at the highest elevations. They show strong shifts in species composition across climate and geologic gradients and many species occur in only part of the region. They have been less studied than upland communities. Common and widespread riparian tree species are typically deciduous hardwoods, including black cottonwood (*Populus trichocarpa*), red alder (*Alnus rubra*), white alder (*A. rhombifolia*), bigleaf maple, Pacific willow (*Salix lucida* ssp. *lasiandra*), Pacific dogwood (*Cornus nutallii*), and Oregon ash (*Fraxinus latifolia*). Important conifers such as Port-Orford cedar, redwood, yew, and Douglas-fir can also be important parts of these forests. At the edge of the Sacramento Valley, a number of southern species occur, including Fremont's cottonwood (*Populus fremontii*), boxelder (*Acer negundo*), and valley oak. At the colder, higher Great Basin steppe margin, aspen, thinleaf alder (*Alnus incana* ssp. *tenuifolia*), and water birch (*Betula occidentalis*) appear, and many of the other species are absent. With increasing elevation, shrub and graminoid-dominated riparian communities are common, and trees become less important.

C. Seasonal Wetlands

A number of communities occur in seasonally flooded areas that subsequently dry out during the summer drought. The most common types include include vernal pools, ephemeral streams, seasonal snowmelt ponds, and snowmelt beds. Vernal pools often have distinctive annual species such as meadow foam (*Limnanthes* spp.), or perennial graminoids such as spiked rush (*Eleocharis* spp.). Ephemeral streams often have species that can tolerate both flooding and seasonal flooding and drought (e.g., Oregon ash). Snowmelt ponds and swales often provide unique habitats for northern alpine species with high moisture requirements, such as bog-laurel (*Kalmia polifolia* ssp. *microphylla*) and Labrador tea (*Ledum glandulosum*).

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